Indian J. Phys. **70B** (3), 259–261 (1996)

IJP B
- an international journal

Conference Report

XIX International Conference on the Physics of Electronic and Atomic Collisions

(held at Whistler, Canada, 26 July — 1 August, 1995)

The atomic collisional cross sections find their applications in a number of fields like astrophysics, upper atmospheric physics, plasma physics, reactor physics, characterization of materials *etc*. The series of conference entitled International Conference on the Physics of Atomic and Electronic Collisions (ICPEAC), which is held biennially at different parts of the world, gives new directions to its participants in the field of atomic collisions. The *state of art* papers and invited talks which are given in these conferences by specialists set new trends in the scientific investigations. The latest in the series XIX ICPEAC, which was held at Whistler, B.C., Canada from July 26 to August 1, 1995, was no exception.

This conference considered collisions involving photons, electrons, positrons, other exotic particles like positronium muonium *etc*., atoms, ions, molecules, clusters and condensed matters. A large number of poster papers, review and progress reports on the above topics were presented.

Starting with photon-atom and photon-molecule interactions, one of the plenary lectures was delivered by Prof. B Sonntag of the University of Hamburg. He discussed *state of art* concerning synchrotron radiation, its present status, anticipated developments and applications to photon collision physics. It was pointed out that in addition to a high degree of polarization and sharp time structure, the two properties of synchrotron radiation that help make it an ideal probe for atomic and molecular investigations, are its high intensity and wide energy tunability.

The second topic which should be of interest to us was the production of cold atomic beams and cold collision processes which occur in traps. In the session entitled 'Novel Techniques' a progress report on 'Production of bright, cold atomic beams for collision experiments' was given by Dr. K A H van Leeuwen of Technical University of Findhoven.

Trapping and Cooling of atoms with laser beams have now produced very cold and dense clouds of atoms. The collisions that occur between pairs of these atoms are important from the point of view of Bose Condensation.

In another progress report, Dr. R Dorner of Frankfurt University described recent studies connected with Recoil-ion-momentum spectroscopy. Using electron momentum and photon spectroscopy in particular, or measuring the energy loss or gain of the outgoing projectile, detailed information has been obtained on the different reaction channels like ionization, excitation, electron transfer or superpositions of these processes. The momentum of the recoiling ion contains important information on the ion-atom reaction like the inelastic Q-value and the collisional trajectory Dr. E C Montemegro of Pontifical Catholic University discussed projectile electron excitation and loss in ion-atom collisions. Dr. T Stohlker of GSI, Darmstadt described resonance electron capture and resonant transfer and excitation studies with high Z projectiles. Such studies are quite relevant to Indian scientists. The availability of three Pelletron machines, one each at Bhubaneshwar, Bombay and Delhi, makes the above studies quite interesting to us and should be encouraged in our country.

Another topic of interest discussed in the conference, was the study of clusters. Till recently, the main experimental tool for the investigation of cluster properties was mass spectrometry. Discontinuities in the mass spectra revealed special features of the electronic structure The conference showed that now photoelectron spectroscopy have been applied to gas-phase clusters in order to map the metal cluster level structure directly A number of contributed papers on fullerene demonstrated the interest which this cluster has generated in different corners of the world. The field of clusters is still quite open and full of excitement and is worth persuing

A section of the conference was devoted to the collisions of ions with surfaces. The neutralization and relaxation of highly excited slowly moving multiply charged ions (charge state $q \gg 1$) with surfaces is of great interest. The rapid neutralization of the approaching ion by resonant capture into high n levels at large distances, leads to the formation of a novel atoms system, known as 'hollow atom'. Such an atom is characterized by a number of vacant inner-shells. These hollow atoms relax by Auger electron emission. However, the Auger emission is rather a slow process Usually, the relaxation to the ground state takes place only at or below the surface. In a paper, Vaeck and Hansen presented their results for the Auger decay rates in hollow nitrogen atoms. Their results showed that Ar^{17+} and Ar^{18+} on being neutralized by silver surface produce K_α satellite and hypersatellite lines which correspond to $2p \rightarrow 1s$ transitions in the presence of different configurations of spectator electrons in $n = 2$ and $n = 3$ shells.

Dr. D Mathur of TIFR, Bombay gave a progress report on 'Wave function overlap effects in collisional excitation and dissociation of molecules'. In his report, collisions between $\Sigma - \Sigma$ and $\Sigma - \pi$ state molecules were discussed. I presented a paper on the inner-shell ionization of atoms by electrons and positrons. A new method has been developed by

us to calculate K-, L- and M-shell ionization cross sections of atoms by positron and electron for impact energies varying from the threshold of ionization to 1 GeV. Our quantum mechanical method is based on first Born approximation but includes corrections for exchange, Coulomb and relativistic effects and also transverse interactions. A single quantum mechanical method covering such a wide energy range and giving good agreement for a large number of atoms, is rare in collisional physics. Hence, it attracted the attention of a large number of participants.

Some of the other topics on which invited talks were given and papers were presented, involved scattering of polarized electrons from atoms and molecules, electron collisions with oriented molecules, ion-atom collisions and their relevance to fusion plasmas, collision of ions with solid (bulk) matter.

The conference clearly demonstrated that the boundaries between physics, chemistry and biology are melting. To understand biological systems a study of collisional processes is quite important. The interaction of high energy photons, to be obtained from synchrotron, with atomic and molecular systems are expected to throw new light on the dynamics of the collisional processes. The investigations dealing with the collision of electrons and ions with clusters, solid surfaces and bulk materials, are of importance. It was recommended that such studies should be encouraged theoretically as well as experimentally. A good scientific investigation requires specialists from various branches. Need for interdisciplinary groups cannot be over emphasised.

Unfortunately, the Indian participation in the conference was not upto the mark. This probably led to the reduction of the number of the Indian representative in the General Committee of the conference from two to one. Dr. Rajesh Srivastava of Roorkee University is our new representative. The next conference of the series will be held at Vienna, Austria from July 23 to 29, 1997.

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